ADAPTABLE ASTUTE UTILITY POLE

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Abstract - In this paper, we are developing an Embedded based application i.e., ADAPTABLE ASTUTE UTILITY POLE. Here we are developing a smart street lamp pole. By implementing this we can reduce the overall energy consumption of the street lamps and providing various smart services. This is a cloud-connected electric street lamp pole so we can control and monitor the pole from a remote location (anywhere in the world). In public places, people may feel a lack of availability of smart devices so this idea is a technological treasure for them.

Keywords – Embedded application,smart street lamp,cloud connected,smart devices

1.INTRODUCTION:

In this smart world, we had so many smart devices like smart phones, watches, TV, etc. but still now we having conventional street lamp poles. Due to the lack of facilities and features of the street lamp pole, we were wasting electric energy and a lack of security among the streets. So we proposed an idea to upgrade the existing street lamp pole to smart pole. Which is serving so many services to the people like

1. Street lamp with autonomous illumination control(image processing)
2. Timer-based on/off system
3. RFID payment based EV charging
4. RFID payment based WI-FI access
5. Environmental monitoring
6. Emergency SOS communication
7. Flood warning and digital sign
8. Mobile charging ports

These are the smart features are available in this proposed idea. Through this, we can save electrical energy consumption as well as improve the security level of the street during night hours, and providing adequate service to the people.Some of the usual methods to control the street lamp pole illumination like LDR based control and

Motion sensor-based control. In these control methods, we had so many disadvantages there are

1. Malfunction of the motion sensors.
2. LDR failure
3. Remote communication distance is less

Here we overcome all the constraints of our existing street lamp pole and developing a smart pole with so many features. In this paper, the cloud-connected street lamp can capable to control the illumination through the internet and collect the various status of the pole.

2. PROBLEM OVERVIEW:

The Energy consumption for street lights is wasting due to lack of smart control. Most of the street lamps are illuminated from evening to morning (approx. 12hrs), but sometimes the street lamp gets always turned ON due to this we wasting the energy.

Recently we prefer electric vehicles than automobile vehicle but we had a problem withthe charging facility. That is waiting time for the charging is may get longer as well as the emergency charging for the vehicle is not available.

Environmental air-quality monitoring is not an active state in domestic locations.

Lack of emergency communication systems during night hours, due to this some of the illegal activities may happen in domestic streets.

3. EXISTING SYSTEM:

The street lights are controlled by some of the motion sensors like PIR and IR sensors. By using this we can predict the motions in the street. But it cannot be able to differentiate the human, vehicles and animal crossing. Due to this malfunction of the street lamp will happen.

Firstly, LDR will sense the intensity value of sunlight and send it to Arduino. Arduino will judge if the received value is above the threshold level (which is set independently by the user from the discrete value: 0-2023), then it will consider it as daytime and LEDs will remain OFF, or if the received value below the threshold level, Arduino will consider it as a night-time. In the night-time, if the value of IR obstacle detector sensor is LOW and detects no object, then DIM LEDs (half of its maximum voltage) will glow, or if IR obstacle detector value is HIGH and detects any object, then HIGH LEDs (full of its maximum voltage) will glow[1].

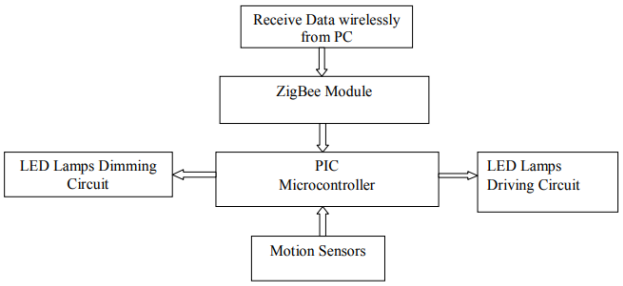

Fig 1. Hardware interface [2].

4. PROPOSED METHOD:

We propose the idea to make a smart street light pole along with the following features

- ❖ Autonomous street light control
- ❖ Environmental air quality monitoring
- ❖ EV Charging
- ❖ SOS system
- ❖ Flood warning and digital signs
- ❖ Public announcement system
- ❖ WI-FI system

4.1. Autonomous Street Light Control:

The energy is unnecessarily wasting because of the absence of smart control. We introducing the three control logics to control the street light. By using RTC,LDR, and night vision camera we can control the brightness of the lamp and implementing an automatic turn ON and OFF technique in the street light. The street lamp illumination can be controlled from a remote location through the cloud. RTC is used to predict the evening and morning time. By calculating the real-time we can send the control signal to the lamp from raspberry pi 3.

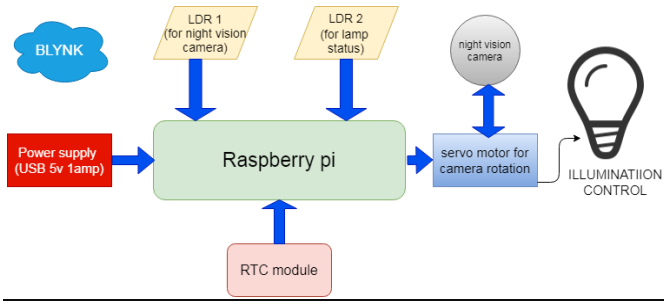

Fig 2.Illumination control

LDR1 is used to find the atmospheric brightness and LDR2 is used to predict the current status of the lamp. Night vision camera is interfaced with the Raspberry pi 3 we can find headcount of the people crossing in the street by image processing. Based on the count value the raspberry pi can automatically control street lamp illumination.

By default, the lamp illumination is reduced to 50% of the total brightness during mid-night. If any movements are sensed by the camera the lamp can increase the brightness itself.

4.2.Environmental Air Quality Monitoring:

In this monitoring method, we are continuously monitoring the air quality and send the exact data to the pollution control board. Through this, they can monitor from remote areas and maintain the environment in a safe level of emission.

We are using a TI CC3200 microcontroller for processing and transmitting data to the cloud. Atmospheric gases are sensed by using the MQ-5 sensor. It can be able to sense 5 different types of gases. MQ-5 is a transducer and it is a resistive sensor. It produces the output in-terms of RESISTANCE.

From the below graph R0=Resistance at pure atmospheric condition, and RS=Resistance when the presence of gases in the atmosphere. Depends upon the ratio (R0/RS) we can find the various gas content present in the atmosphere.
DHT-11 and MQ-5 sensors are interfacing with the CC3200 microcontroller and connected to the Blynk server.

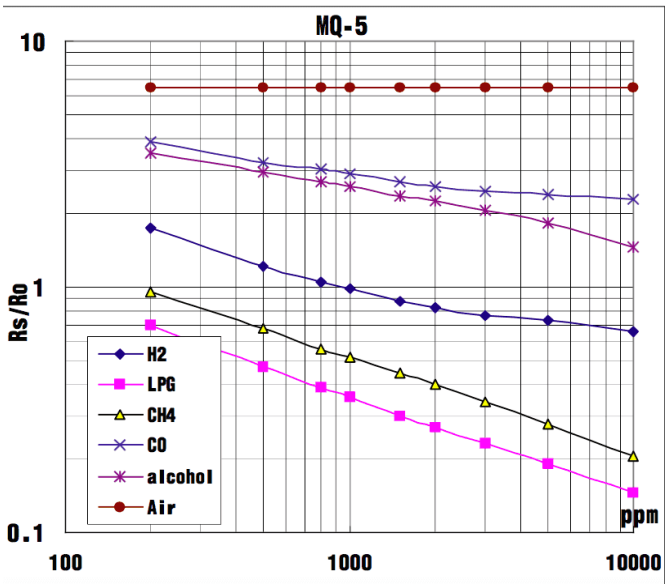

Fig 3. Resistance Vs ppm

4.3. EV Charging:

- In modern electric vehicles having lithium-ion batteries. Because it has a high energy density.We prefer a CCCV protocol to charge the electric vehicle. Moreover, it is an emergency charging station so it is not a fast charging method.
- For e.g.:
  - EV charger unit: 230/15amp
  - Power = 3.4kw
  - Per hour=3.4kwhr
  - Mileage = depends upon vehicle capacity.

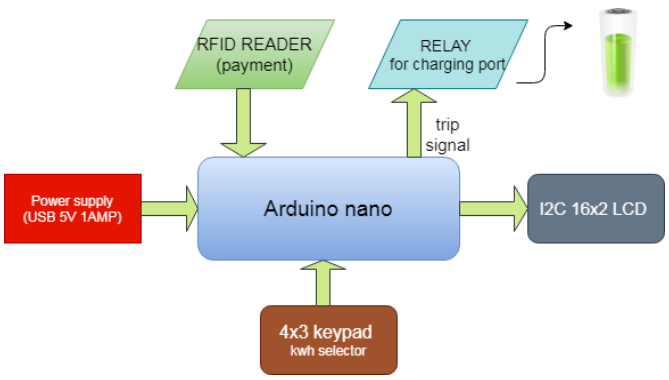

Fig 4.EV Charging Block Diagram

- Every smart electric pole having a capacity of producing a 230v/15A DC output supply for charging the EV. We have a KWh selector switch to charge the battery.It is an emergency charging station to avoid the electric vehicle battery completely drains state.
- Some amount should be payable through RFID based payment mode for electric charging.

4.4. SOS System:

- The **Full form of SOS** is **'Si Opus Sit'** which means 'if needed'. SOS means a Morse code in old times which is used as a distress code to signal danger.During night hours we have a lack of safety and security system from robbers and other issues.Due to this, we make an emergency contact system.
- We allotting different frequency bands for contacting the police station, fire service department, ambulance, etc. The user can press the key to contact the appropriate departments. RF transmitter module KTC0803 is interfaced with the Arduino nano by I2C protocol. The frequency band can be easily changed by the Arduino Nano microcontroller.

Fig 5. RF Audio Transmitter I2C

An external microphone is installed with this pole for converting the voice to an electric signal. A microphone can be used for an emergency communication system and a public announcement system.

- Radiofrequency band (90 to 108MHz) is used to transmit the voice.Depends upon the antenna height transmission coverage is increased.
- For 30cm antenna distance coverage is 200m.

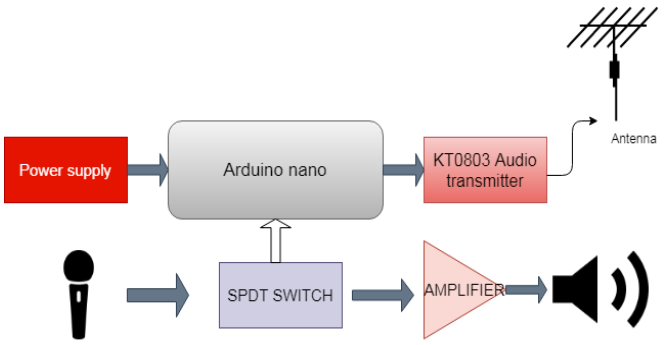

Fig 6.SOS and PAS System

4.5. WI-FI Service:

Asper today's scenario, internet accessibility is important to people.Hence public Wi-Fi system becomes indispensable so we provide here a fast payable Wi-Fi service to the people who near to the pole. Here we using ESP-01 and nodemcu controllers. ESP-01 is configured to run as an Access Point(AP MODE) to share the internet among the users.

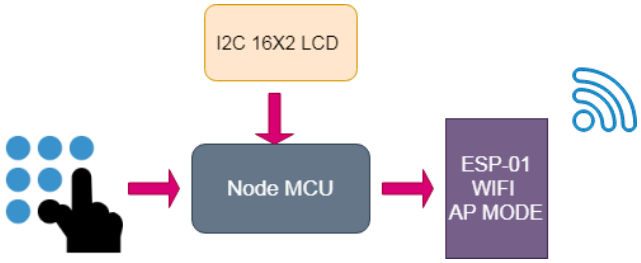

Fig 7.WIFI Service

4x3 keypad and i2c display are interfacingwith the nodemcu for user interface purposes. The OTP for accessing the wifi is displaying either on i2c LCD or SMS based OTP generation.

This is a payment based emergency wi-fi access system, so payment may be done by the RFID tag.

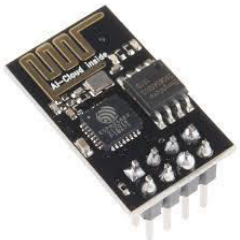

Fig 8.ESP-01 **Fig 9.**NODEMCU

For OTP based password generation the nodemcu microcontroller should be connected with the BLYNK server.

4.6. Digital Sign:

Important announcement and data aredisplayed in the smart street light pole by using an 8x8 dot matrix display. The following information's can be displayed

- Street name

- Bus route numbers
- Time and Date
- Air quality index
- Traffic signs
- Temperature level etc.

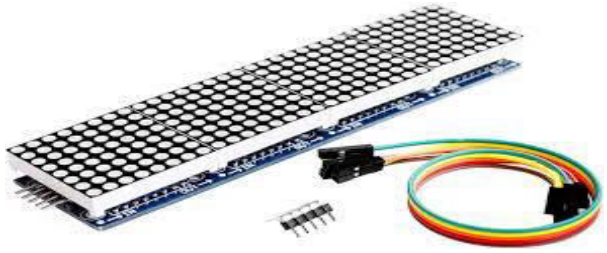

Fig 11.MAX7219 Display

4.7.Flood warning and digital signs:

Every year we were facing so many issues due to natural disaster especially during the rainy season like floodwater in urban areas. Due to the failure of GSM communication (lack of availability of network coverage), the people can't able to contact the disaster management team. Here we are giving the solution for that, we propose an idea like every smart pole should having floodwater monitoring circuits. It continuously monitoring during rainy conditions and send the data to the disaster management team with exact location through the BLYNK cloud server. With the presence of continuous monitoring, the disaster management team can immediately come and rescue the people so that we can save valuable human lives.

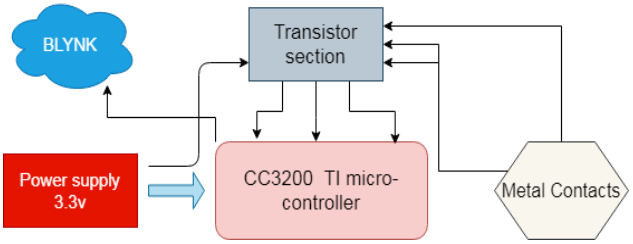

Fig 10.flood warning system

Cc3200 TI microcontroller is used to monitor and send the data of the street to the control center. The transistor section is used to act as a switch to sense the water level of the street during flood conditions.

5. OBSERVATION:

As we said the illumination of the lamp can be controlled through the internet by using the BLYNK server. In **fig 12** the flood monitoring, air quality index, air ratio, and location of the street lamp pole like these all are monitored from the remote location.

For the detection of atmospheric brightness, we used LDR. Depends upon the resistance value we can predict the atmospheric condition. The fig[13] shows the RESISTANCE Vs ILLUMINATION variations.The following images show how we can control through mobile.

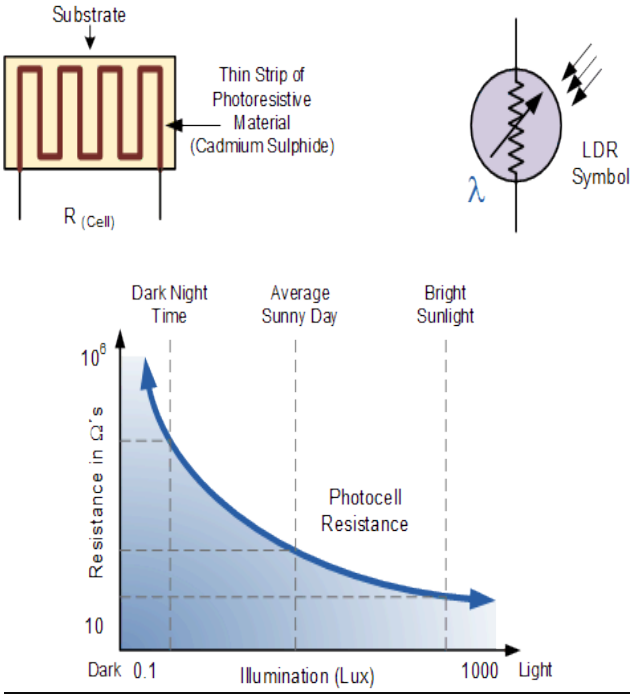

Fig 12. LDR Response

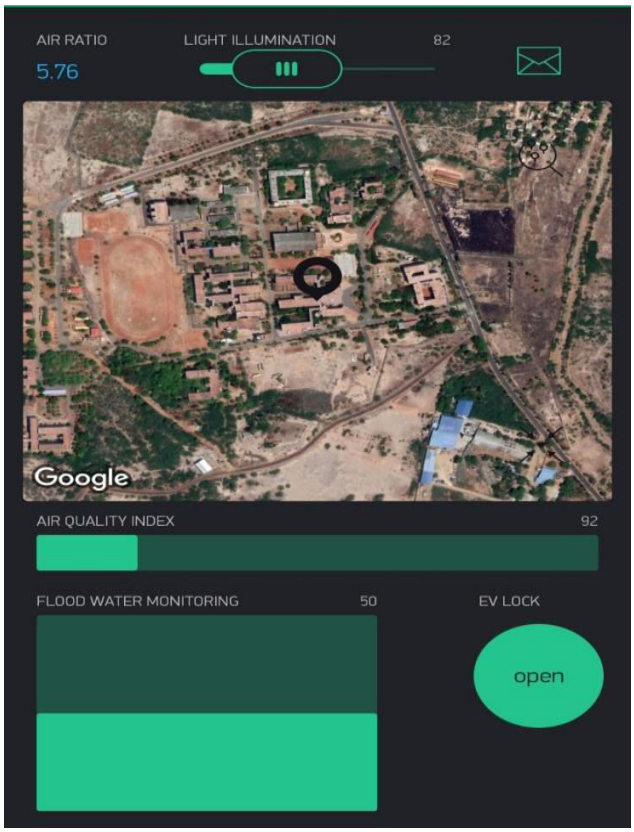

Fig 13. Mobile Application

In fig [15] ouremergency charging section the payment can be done by RFID technology. By using the relay we can turn ON and OFF only after the payment process is done. The working status of the EV charging section can be ensured by the following images,

Fig 14. Illumination of a street lamp

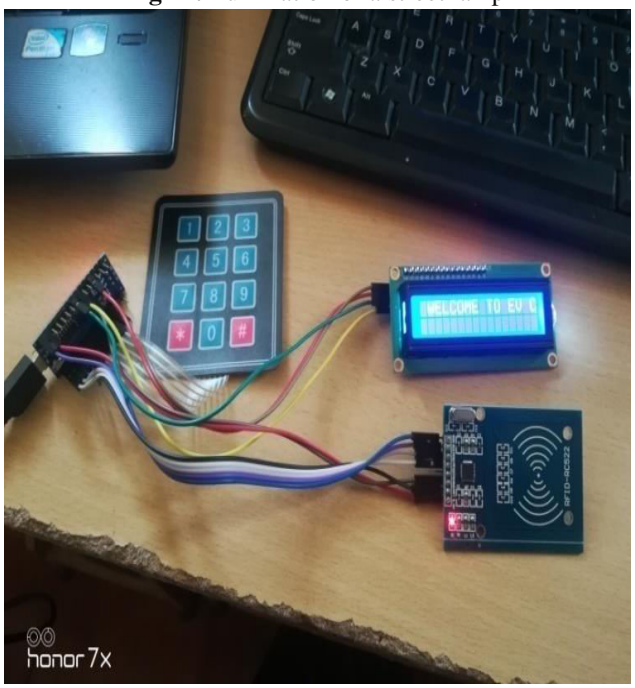

Fig 15. EV Charging User Interfacing

6. CONCLUSION:

The implementation of smart devices and services in public places can be achieved by our proposed method. Our proposed idea definitely will enhance public services. If we install the smart street light pole in real-time like smart cities, it will attract the users and we can satisfy the technological needs of the people. And more-over this smart pole can provide some regular income for whose installing these poles.

In the existing system, we don't have these kinds of features. Some of the existing smart street light poles are expensive, Even though it having fewer features. But we proposed to make a smart pole at a reasonable cost.

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